

SDSS-II Supernova Survey (continued)

David Cinabro

Wayne State University

AIPW, Dubrovnik, Croatia 4-9

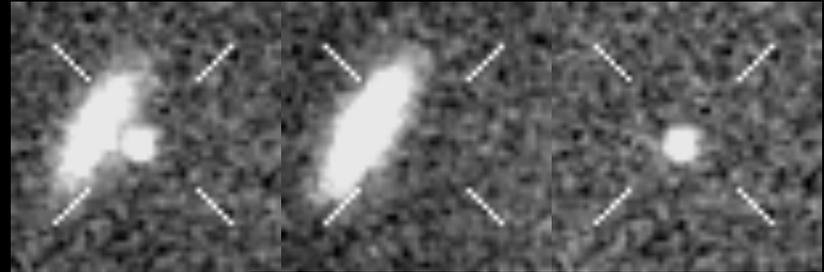
September 2006

SDSS-II Supernova Survey

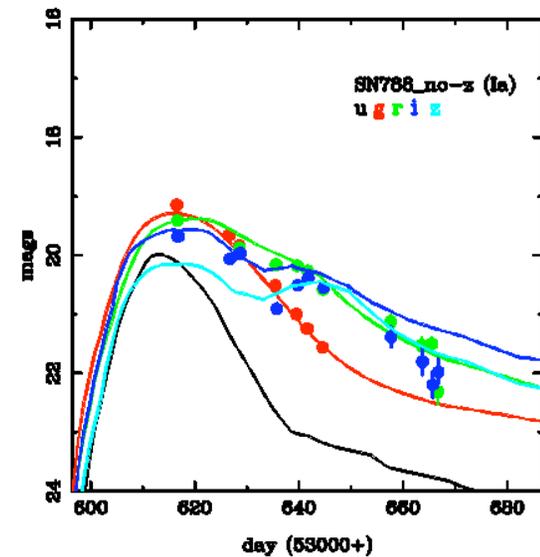
- Preliminary SNIa Volumetric Rate
- Core Collapse SN: Steps towards measuring rates
- Proposed Extension to our Survey, focus on Redshift < 0.2 to gather an additional ~250 high quality SNIa light curves

Preliminary Volumetric SNIa Rate

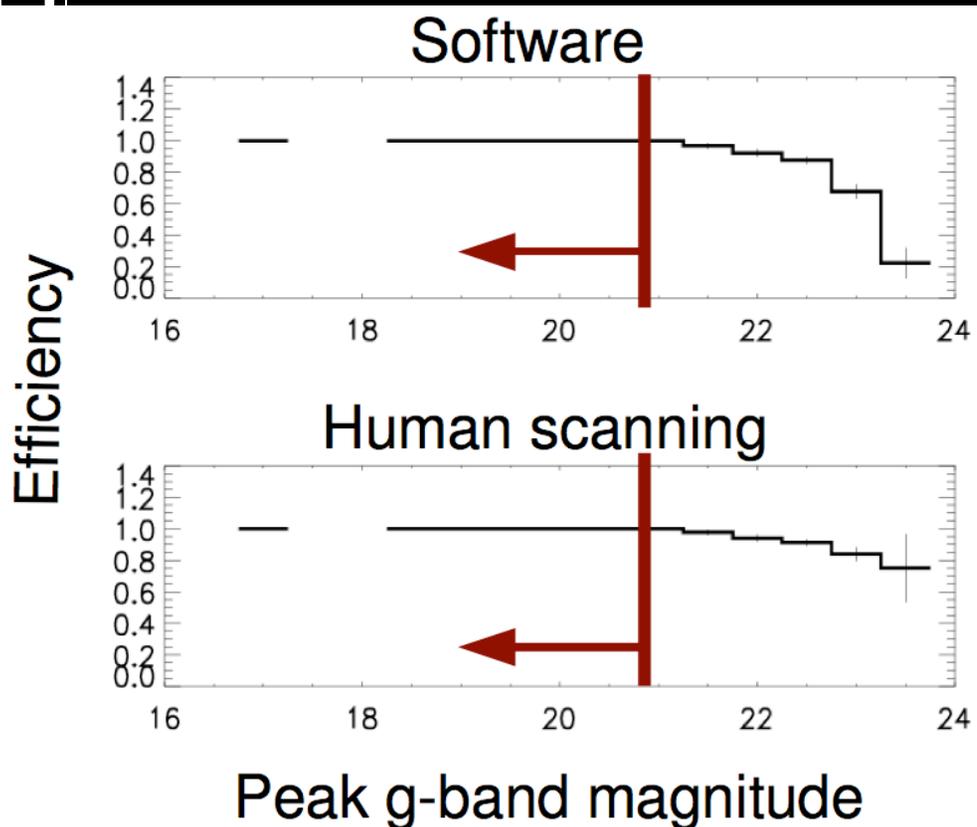
- Understanding of progenitor source (White Dwarf plus something else)
- Efficiency depends on search software + hand scanning
- Monitored with Fakes inserted into real data and scanned blindly



Fake



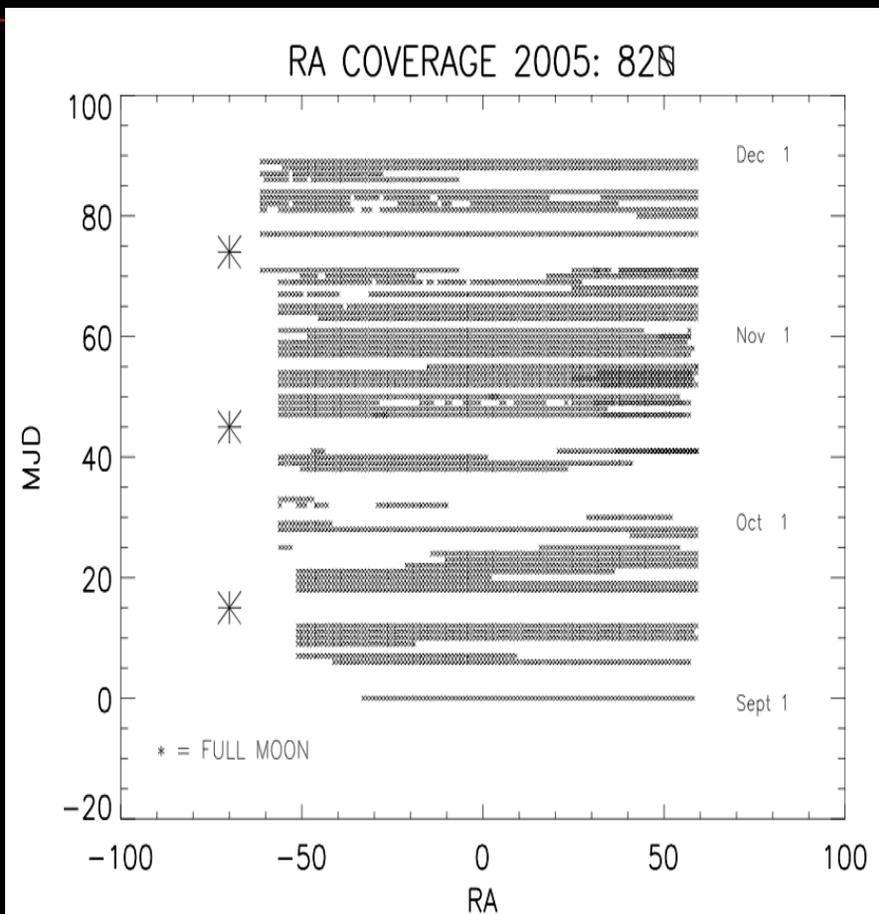
Preliminary Volumetric SNIa Rate



- Checks search software (template subtraction, finding objects) and hand scanning efficiency.
- 100% for peak magnitude < 21 for SNIa peaking in our 3 month search season

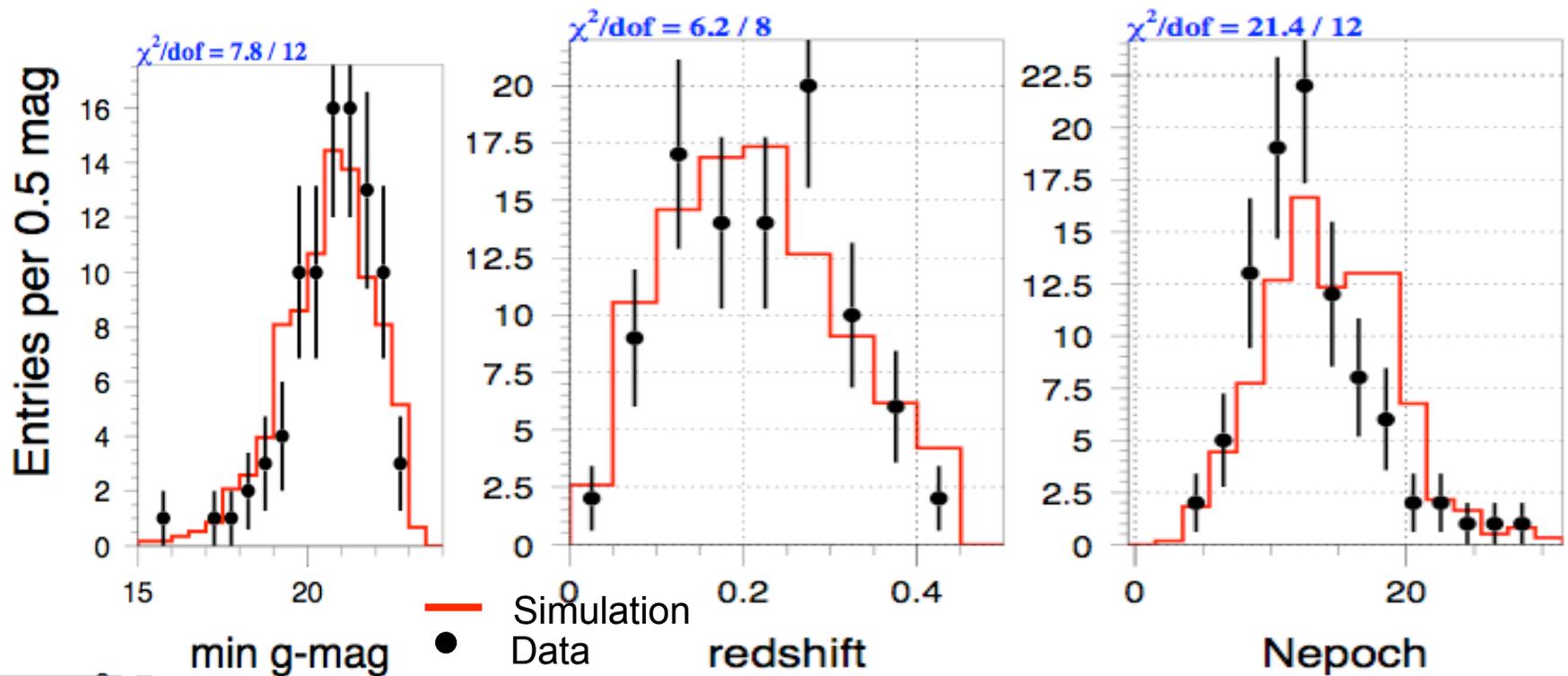
Preliminary Volumetric SNIa Rate

- Thus measure rate at Redshift < 0.12
- Simulate search with a Monte Carlo which takes into account weather, sky conditions, and SN Ia diversity.



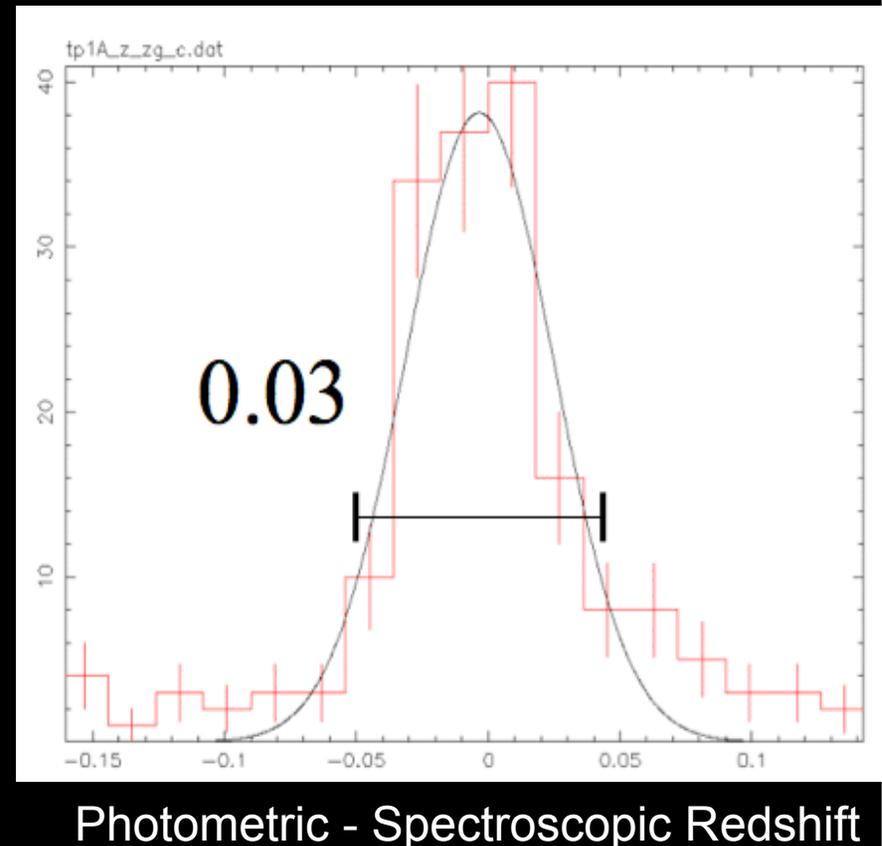
Preliminary Volumetric SNIa Rate

- The simulation models the data well. No redshift cut here.



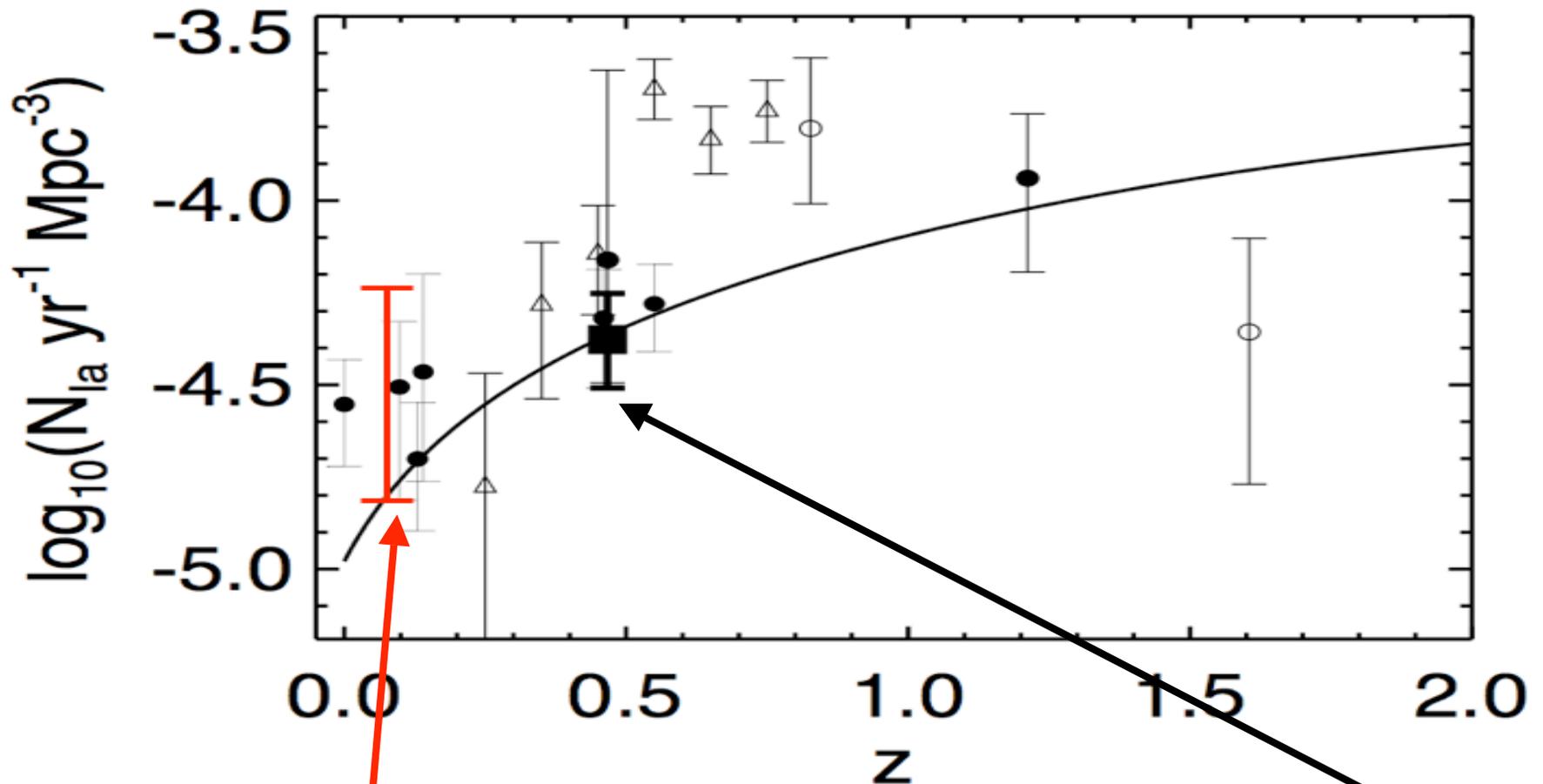
Preliminary Volumetric SNIa Rate

- Rate sample selections (Redshift < 0.12 , at least one Epoch 2 days before peak, at least one Epoch more than 15 days after peak, at least 5 Epochs total)
- **18** Spectroscopically confirmed SNIa + **9** photometric only SNIa
- Spectroscopic redshifts measured to 0.0005



Preliminary Volumetric SNIa Rate

- Optimistic Assumptions (Negligible galaxy background, no extinction, width of Ia stretch = 0.1) give efficiency = 87%
- Pessimistic Assumptions (Mag 16 galaxy background, exponential A_v with slope = 0.2, width of Ia stretch = 0.2) give efficiency = 85% \longrightarrow not much sensitivity.
- Rate upper limit from 27/0.85: $(4.46 \pm 0.8) \times 10^{-5}$ $(h_{70}/\text{Mpc})^3/\text{yr}$
- Rate lower limit from 18/0.87: $(2.97 \pm 0.7) \times 10^{-5}$ $(h_{70}/\text{Mpc})^3/\text{yr}$



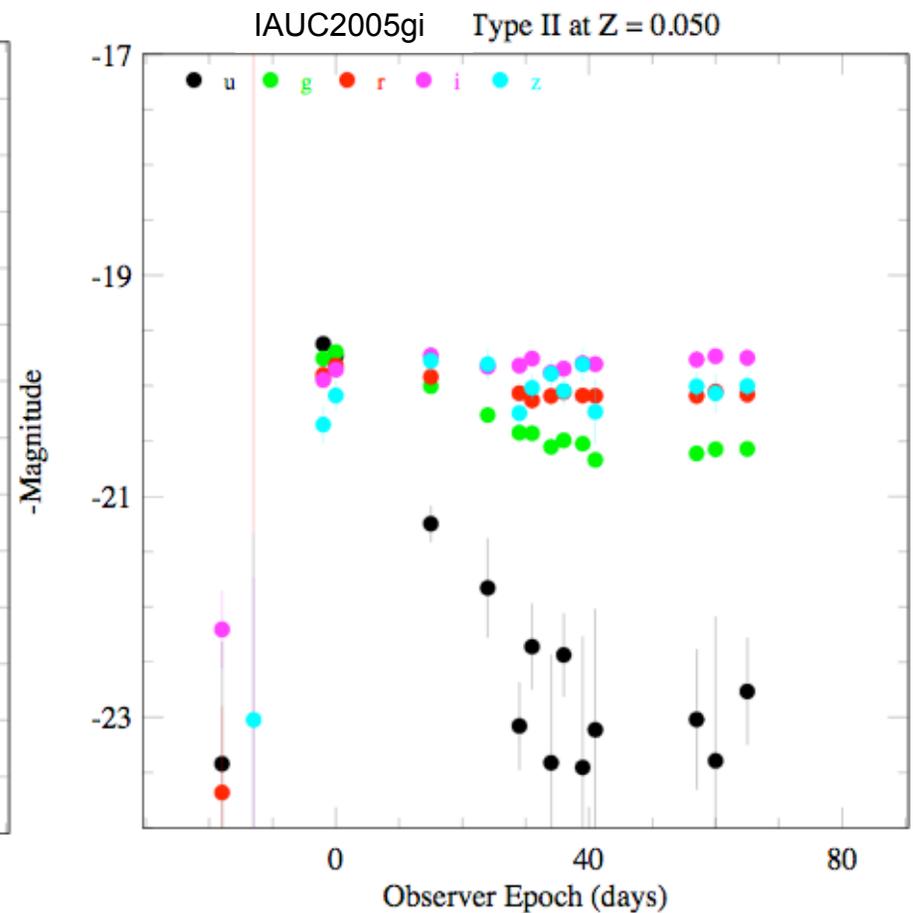
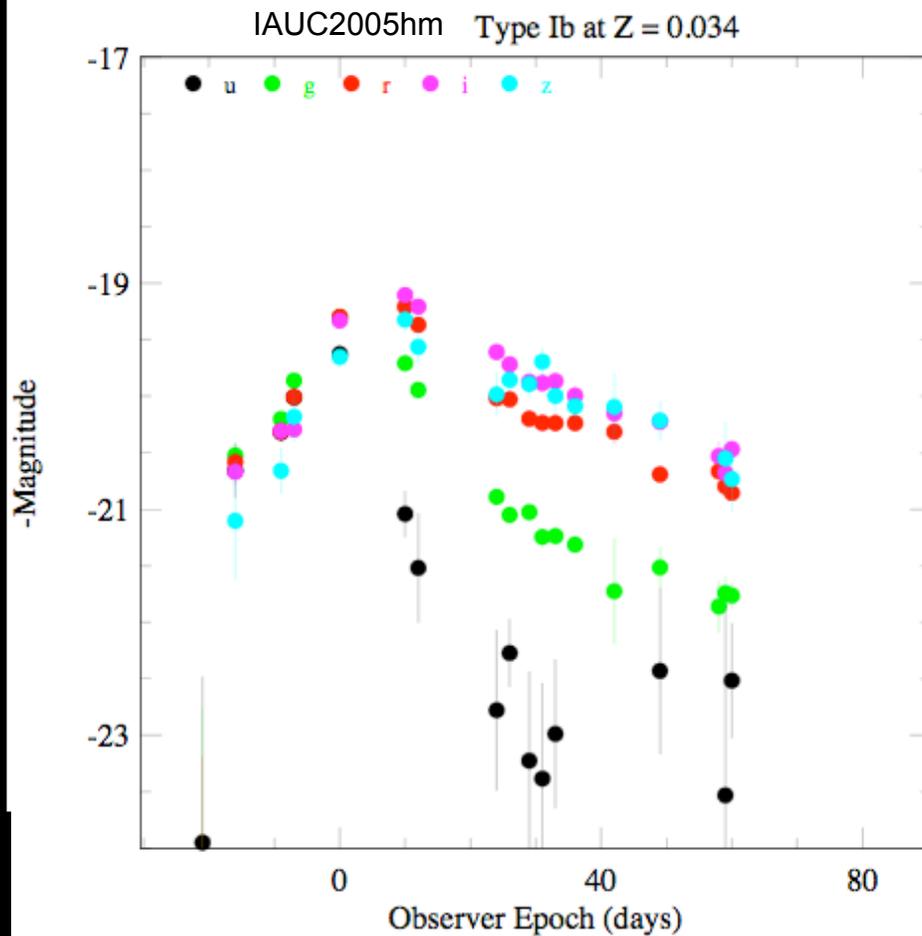
Compare SDSS at $\langle z \rangle = 0.09$ based on 18-27 SNIa with SNLS at $\langle z \rangle = 0.47$ based on 73 SNIa (from J.D. Neill et al. astro-ph/0605148)

Core Collapse SN: Towards Rates

- Not the focus of the SDSS SN survey, spectroscopic resources primarily dedicated to SNIa
- Nevertheless we pick up a decent sample of SNIb/c and SNII.
- Including 2004 1.5 month pilot run and 2005 3 month campaign we have 7 SNIb/c and 12 SNII unambiguously identified with spectroscopy.

Core Collapse SN: Towards Rates

- We get some very nice core collapse light curves.

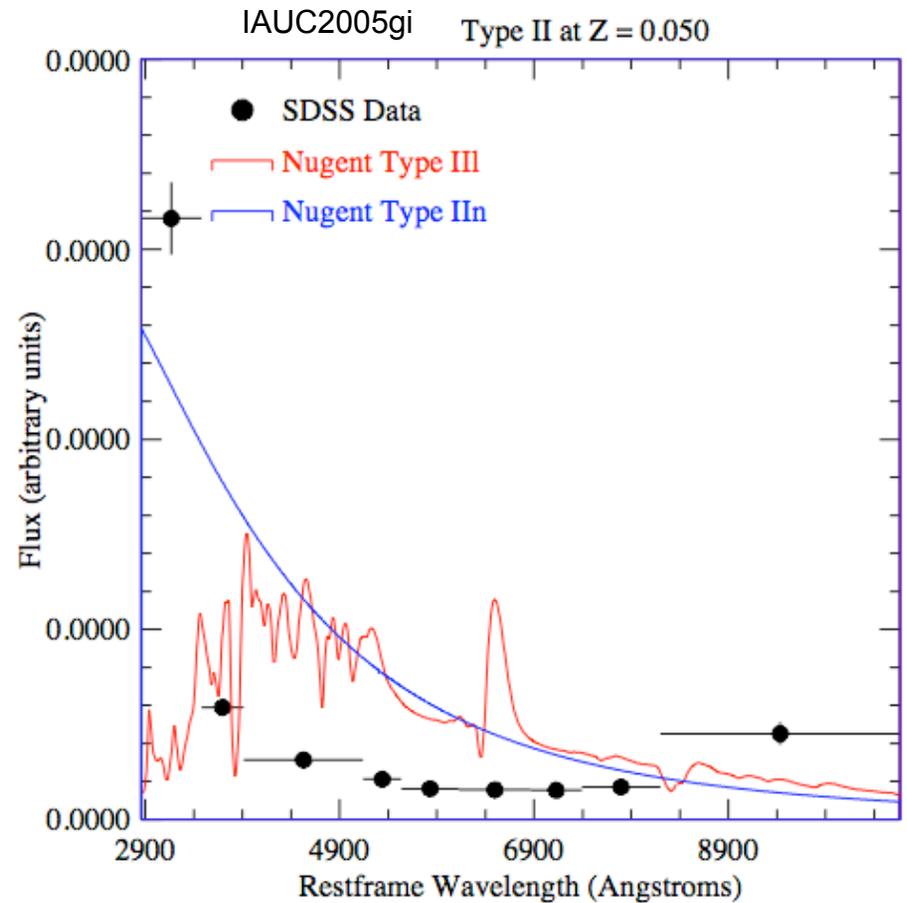
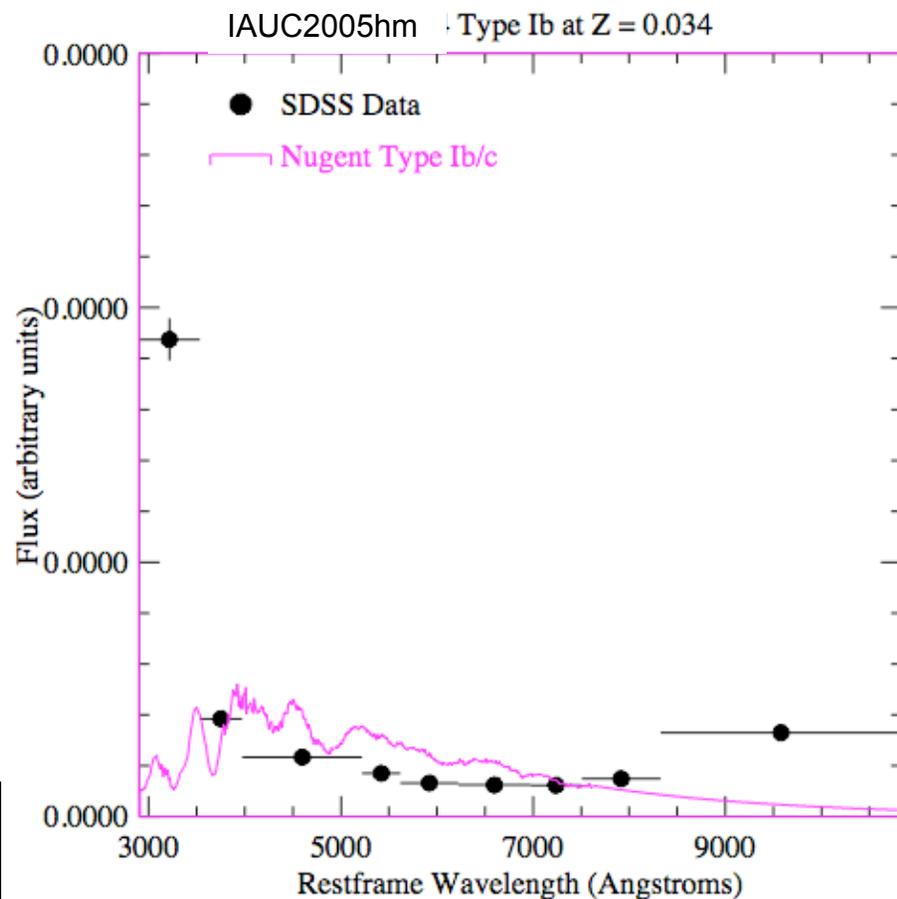


Core Collapse SN: Towards Rates

- Thus the plan to use SDSS photometry as “low resolution spectroscopy” to build Spectral Energy Distributions for the core collapse SN that we observe to build a library of Core Collapse light curves that we can use to search for them photometrically
- Compare these two with standard core collapse SED's (http://supernova.lbl.gov/~nugent/nugent_templates.html) after taking into account filter response, Milky Way extinction, and blueshifting.

Core Collapse SN: Towards Rates

Compare SED's at peak.



Core Collapse SN: Towards Rates

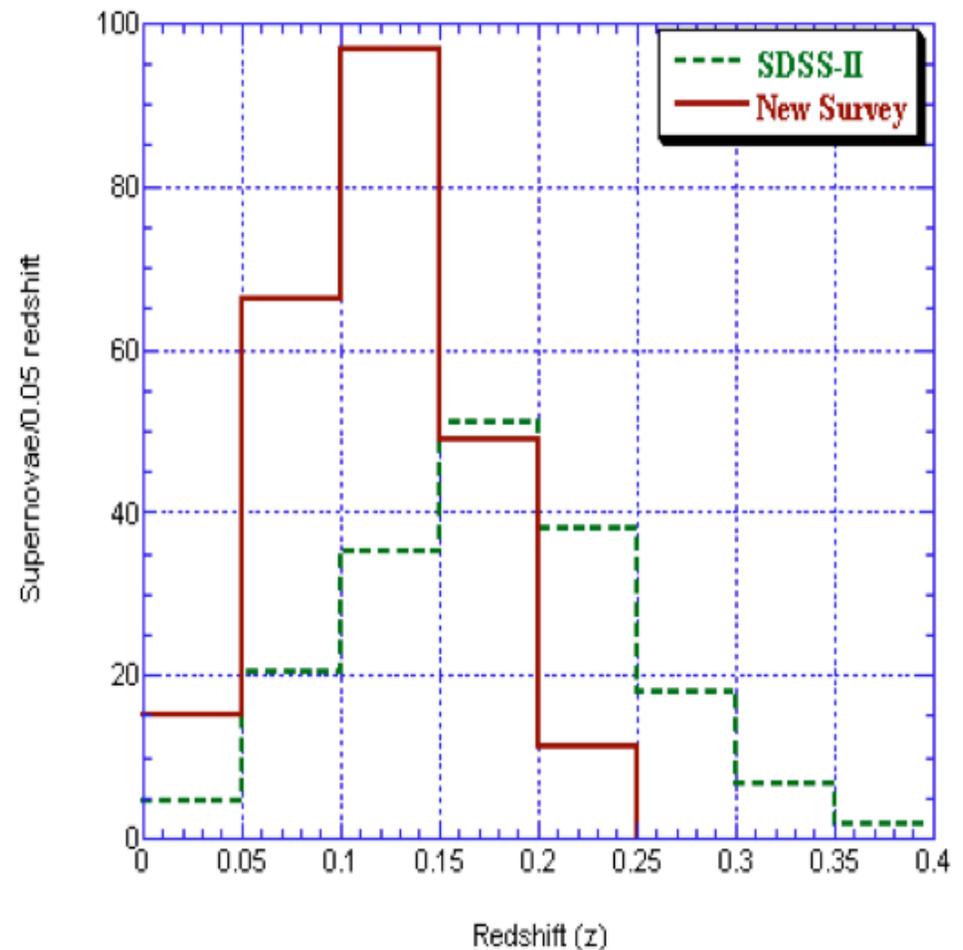
- Results are surprisingly good
- We have 3 good SNIb/c and 5 good SNII SED's derived from our own observations that we are including in our photometric search this season (already had been using core collapse templates from Nugent and SUSPECT, 10 total)
- Would like more core collapse SED's from other sources (CSNP, Cfa, KAIT,...)
- Eventually hope to measure a core collapse rate

Extension to SDSS SN Survey?

- In response to ARC RFP for 2008+
- Submitted ~1 August, response expected by end of September
- Shift focus to lower redshift supernovae by increasing drift scan rate from sidereal to three times sidereal and thus cover more sky, but see less deeply

Extension to SDSS SN Survey?

- Total rate similar, but rate for redshift < 0.15 is roughly quadrupled
- Expect ~ 250 good SNIa light curves (500 total) in 9 contiguous months
- Combine with multi-epoch spectroscopy



Extension to SDSS SN Survey?

- Excellent “Anchor” for the Hubble diagram
- Systematic study of SNIa
- Improved SNIa Template especially at early times
- Study K-Corrections
- Search for Peculiar SNIa
- Very accurate SNIa low redshift rate
- Many core collapse SN also

Conclusions on SDSS SN Survey

- Preliminary SNIa volumetric rate. In August 2006 we took host spectra for all photometric candidates. Improved SDSS rate out soon.
- Progress on a Core Collapse rate.
- Proposal to gather ~250 high quality SNIa light curves at low redshift in an extension to SDSS SN Survey.